



2017

Spring 2017

Even partial solutions and attempts can gain marks.

Neat and careful work is important.

Hand in only one team answer sheet for each question.

Question 1 Des rangées dérangées

7 MARKS

Give your answer in French, Spanish, German or Italian using a minimum of 30 words.

Dans une salle de réunion, il y a neuf rangées ayant le même nombre de chaises.
Pour la première conférence, tous les participants sont là et la salle est pleine aux deux tiers.
Pour la deuxième conférence, seuls trois quarts des participants se sont inscrits.
Pour éviter trop de places vides, les organisateurs veulent enlever des rangées complètes de chaises.

Combien faut-il prévoir de rangées complètes pour la deuxième conférence ? Justifier.

In einem Konferenzraum befinden sich neun Stuhlreihen. Jede Reihe besteht aus derselben Anzahl von Stühlen. Bei der ersten Konferenz sind alle angemeldeten Teilnehmer anwesend, aber nur zwei Drittel der Stühle sind besetzt.
Für die zweite Konferenz haben sich nur drei Viertel der Teilnehmer angemeldet. Damit nicht zu viele Stühle leer bleiben, wollen die Veranstalter ganze Stuhlreihen aus dem Saal entfernen.

Wie viele ganze Stuhlreihen müssen im Saal bleiben, damit bei der zweiten Konferenz jeder angemeldete Teilnehmer einen Sitzplatz hat? Begründet eure Antwort.

En una sala de reunión, hay nueve filas con el mismo número de sillas.
Para la primera conferencia, están todos los participantes y la sala está llena en sus dos terceras partes.
Para la segunda conferencia, sólo las tres cuartas partes de los participantes se han inscrito.
Para evitar que haya demasiados sitios vacíos, los organizadores quieren quitar filas completas de sillas.

¿Con cuántas filas completas hay que contar para la segunda conferencia? Justifica la respuesta.

Question 1 Plus ou moins de moins ?

7 MARKS

In una Sala Riunioni, ci sono nove file con lo stesso numero di sedie.
Per la prima conferenza, sono presenti tutti gli iscritti e la sala è piena per due terzi.
Per la seconda conferenza, solo tre quarti degli iscritti partecipano.
Per evitare troppi posti vuoti, gli organizzatori desiderano togliere delle file complete di sedie.

Quante file complete occorre prevedere per la seconda conferenza? Giustificate la risposta.



Question 2 Shikaku

5 MARKS

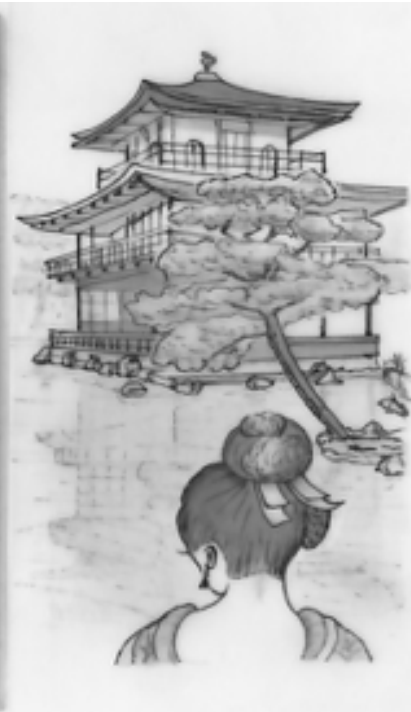
Nicole likes Japanese games like *shikaku*.

In the game you need to completely cover a square grid with rectangles.

In the grid below the number of squares that each rectangle covers is written somewhere inside each rectangle

Copy the grid given below onto square paper and then show clearly how the rectangles cover it.

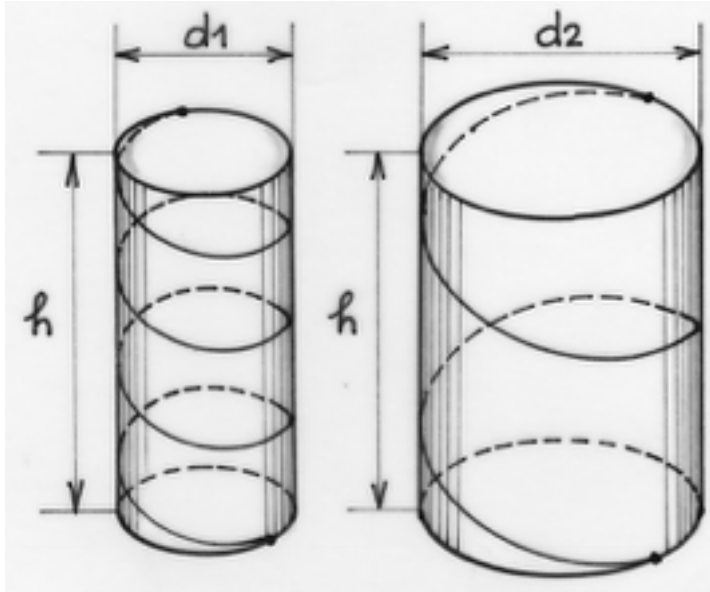
			2		4			3
8				5				2
9		2	4			9		10
							11	
		3		16				5
15						5		
			28					3
							1	
							2	
3								8
11								



Question 3 Turn, turn, turn

7 MARKS

Give your answer in French, Spanish, German or Italian.



Deux guirlandes sont enroulées autour de deux piliers cylindriques verticaux de même hauteur et de diamètres différents.

Les deux guirlandes montent du sol au plafond en suivant la même pente par rapport au sol horizontal.

Laquelle est la plus longue ? Justifier.

Um zwei zylinderförmige Säulen, die gleich hoch sind, aber verschiedene Durchmesser haben, werden zwei Girlanden so gewickelt, dass sie vom Boden bis zur Decke konstant dieselbe Steigung beibehalten. Girlande 1 weist dieselbe Steigung auf wie Girlande 2.

Welche Girlande ist länger? Begründet eure Antwort.

Question 3

Turn, turn, turn

7 MARKS

Dos guirnaldas se enrollan alrededor de dos pilares cilíndricos verticales con la misma altura y de diferentes diámetros.

Las dos guirnaldas suben desde el suelo hasta el techo siguiendo la misma pendiente con respecto a la horizontal del suelo.

¿Cuál es la más larga? Justifica la respuesta.

Due ghirlande sono avvolte su due colonne cilindriche verticali della stessa altezza e diverso diametro.

Le due ghirlande salgono dal suolo al soffitto mantenendo la stessa inclinazione rispetto al pavimento orizzontale.

Una delle due è più lunga? Motivate la risposta.



Question 4 Sagrada Familia

5 MARKS

At the entrance to the *Sagrada Familia* in Barcelona, there is a square grid filled with 16 numbers, a bit like a magic square.

In the grid it is possible to divide the 16 numbers up into 4 groups of 4 numbers so that for each group the sum is 33. There are many ways to do this.

Find five different ways to arrange the numbers in the square into four groups. Make five diagrams and colour the groups with different colours.



1	14	14	4
11	7	6	9
8	10	10	5
13	2	3	15

Question 5

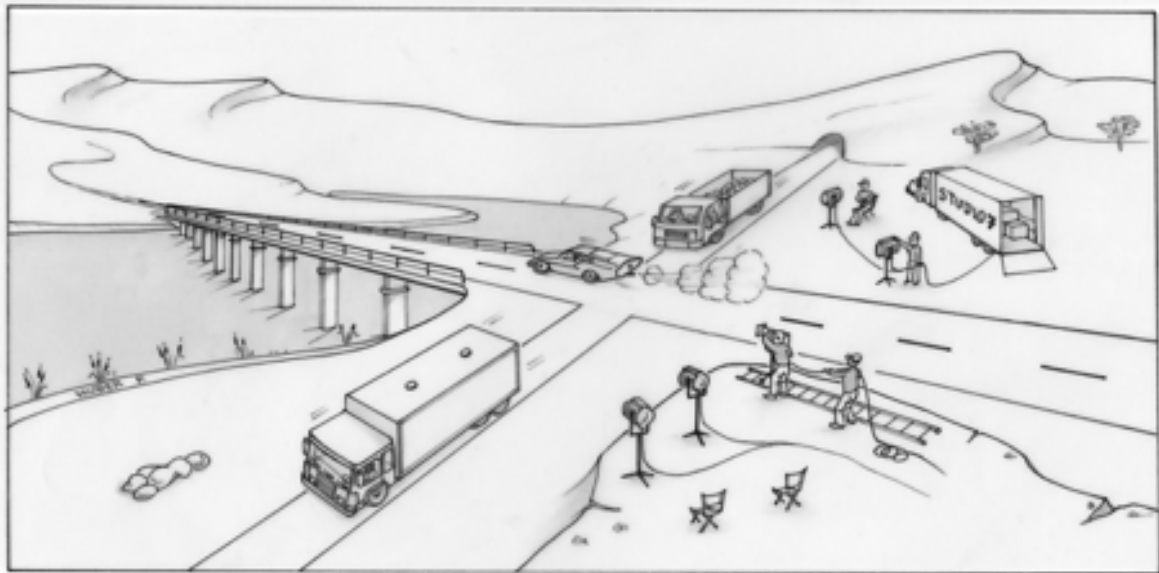
That was close!

7 MARKS

During a chase scene in a film the car has to go between two lorries.

The two lorries are driving at a constant speed of 90 km/h. They are going in the same direction, in a straight line, and one behind the other. They are 20m apart. Each truck is 2.50m wide. The car is going at a constant speed on the road perpendicular to the direction of the lorries. The car is 4.70 m long and 2 m wide.

Calculate the minimum speed for the car so that the chase scene can go ahead without an accident.



Question 6

Number crunching

5 MARKS

Simon writes down a list of numbers. The first number is 3.2.
To find the next number he uses this rule:

*Exchange the whole number part with the decimal part (3.2 becomes 2.3)
then subtract the smaller number from the bigger number (so $3.2 - 2.3 = 0.9$)*

Then with the new number he applies the rule again. In this way he can find the sequence of numbers in his list. The first three numbers on his list are 3.2; 0.9; 8.1.

Find the 38th number. Suggest a method of finding the numbers without writing out the whole list. Write down the 2017th number.



Note: Simon thinks in French. In France a comma is used instead of a full stop for decimal numbers.

Question 7

Cuboctahedron

7 MARKS

On each of the faces of a cube of edge c , I have drawn a square by joining the midpoints of the edges. The lines that I have drawn then help to form eight pyramids, one for each vertex of the cube. After taking away these eight pyramids I get a new convex polyhedron called a cuboctahedron.

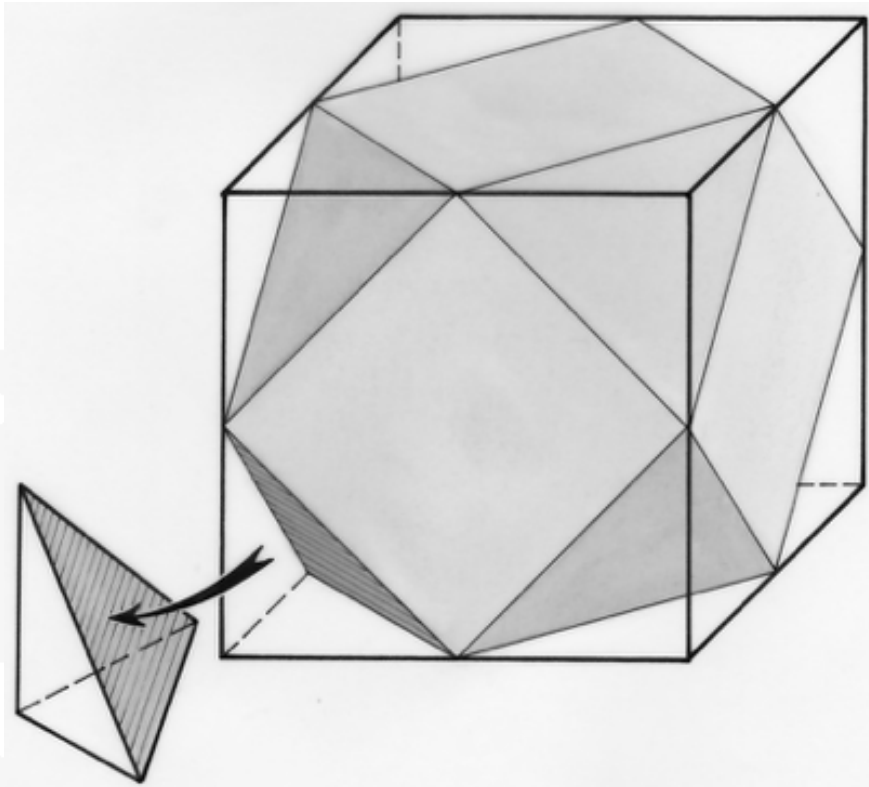
For every convex polyhedron the mathematicians Euler and Descartes both proved the relation

$$V - E + F = 2$$

where V is the number of vertices, E is the number of edges and F is the number of faces.

Show that the relation is true for this cuboctahedron.

Express the volume of the new solid in terms of c .



Find out about:

Leonhard Euler (15 April 1707 – 18 September 1783), Swiss

René Descartes (31 March 1596 – 11 February 1650), French

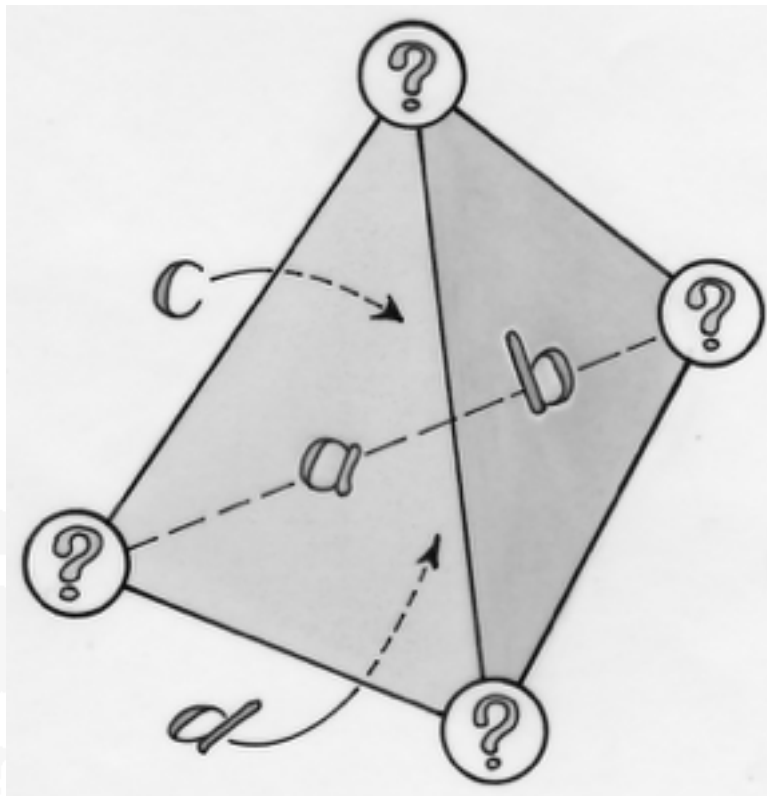
Question 8

Some total _____

5 MARKS

On the four faces of a tetrahedron four different whole numbers have been written. At each vertex you can find the number which is the product of the three numbers written on the faces touching that vertex. The product of the four numbers at the vertices is 27,000.

Find the four numbers written on the faces of the tetrahedron.



Question 9

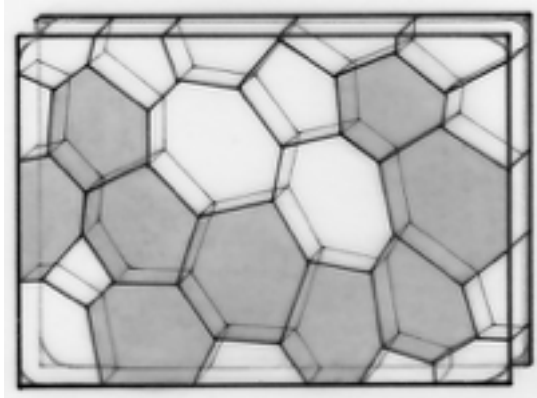
Soapy bubble

7 marks

Soap bubble solutions held in between two parallel planes tend, in the main, to form convex hexagons.

Construct a hexagon which has:

- **all its angles equal to 120° ;**
- **sides of length : 2; 4; 6; 8; 10 and 12 centimetres.**



Using isometric paper might be useful.



Question 10

Similar but not the same

10 MARKS

Draw an isosceles triangle ABD so that $AB = AD = 1$.

Mark a point C on the line AB. Do not place C at either A or B. Draw the line CD.

Draw a line through B, parallel to CD, to cut AD extended at E.

Show that $AE = \frac{1}{AC}$

On a new diagram starting with the same triangle ABD and a point C, find a construction that would allow you to find the point F such that $AF = AC^2$. Justify your answer.



Thales of Miletus was the first to understand similar triangles.

Question 11

Heads or tails

5 MARKS

Senior classes only

Piera and Frank are playing heads or tails with a coin. At the start both friends have five sweets.

If the coin comes down heads, Frank gives Piera a sweet.

If the coin comes down tails, Piera gives Frank a sweet.

The play four rounds each, one after the other.

What is the probability that Frank will have more sweets than Piera at the end of the game. Justify your answer.

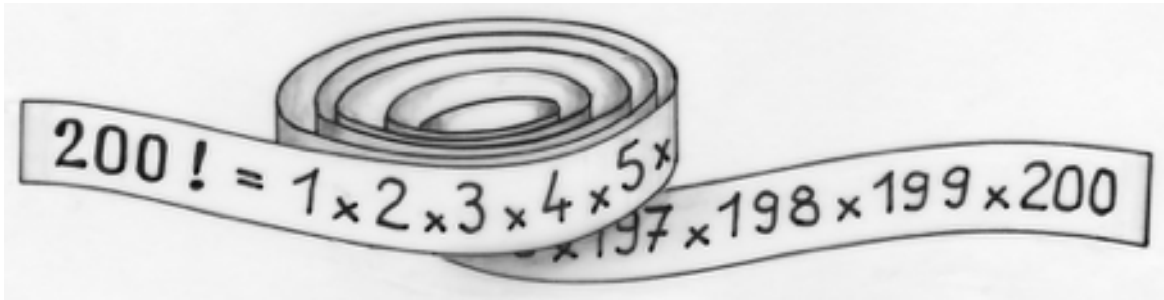


Question 12 Factorial!

7 MARKS

Senior classes only

How many zeroes does the product of every whole number between 1 and 200 end in? Explain your answer.



This special product is written 200!

It really does have an exclamation mark! It is read as 200 factorial or factorial 200. The exclamation mark might be used as it is a surprising product, it certainly gets very big very quickly.



Question 13

Losing the plot

10 MARKS

Senior classes GT

Mehdi wants to buy a plot in Poplar Wood so that he can build a house. All the plots for sale are rectangular.

He wants a plot that has an area of more than 500 m^2 .

And now there are only plots 1, 2 and 3 left for sale.

Would one of these three plots meet Mehdi's requirements? Justify your answer.

